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UK CL (Edition M) **G1S SAM SAN SAP SAQ SAR**
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(54) **Testing vehicle door sealing strips.**

(57) A sealing strip (4,5) to be tested is mounted on a platten 22 connected to a force measuring unit 20. A height measuring unit 36 having a probe 40 extending through a hole 34 in a contact plate 32 measures the initial height of the sealing part. Contact plate 32 is then lowered so as to compress the seal by a predetermined amount. The resultant force is measured by the unit 20 and plotted on a pen-recorder which shows how the force gradually reduces over a period of time due to "relaxation" in the material of the seal. After a fixed period (e.g. 24 hours) the contact pressure is removed and the unit 36 in conjunction with the pen-recorder measure the height of the seal to which it resiles and the rapidity with which it reaches this height (Fig. 5).

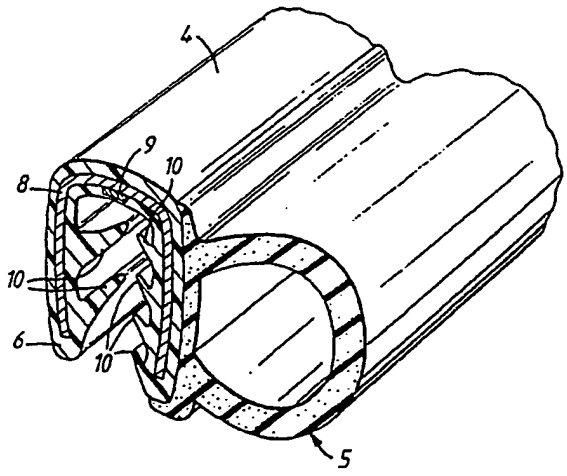

Fig.1.

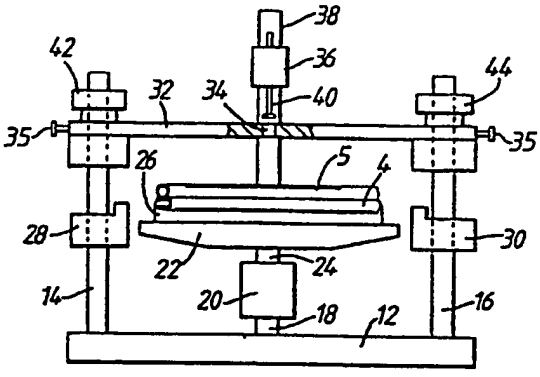

Fig.2.

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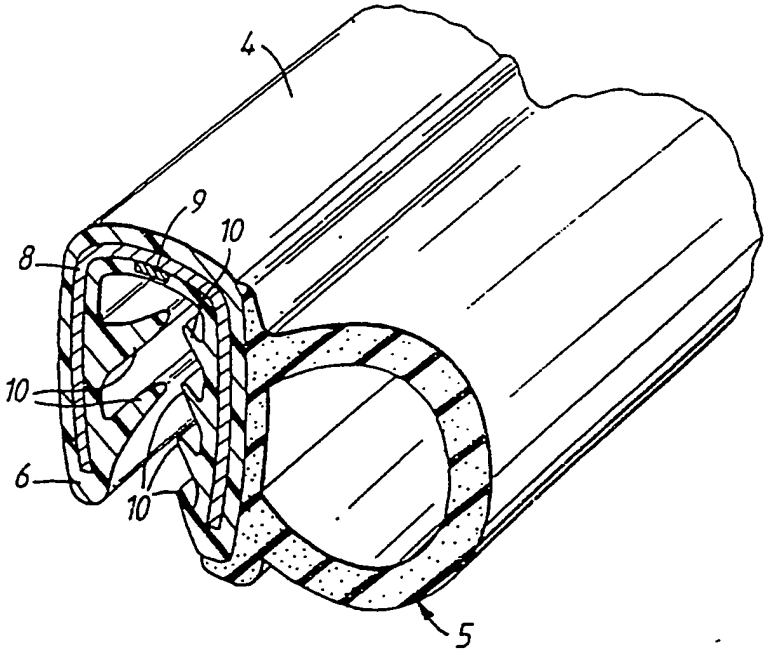
4
9
10
8
10
6
10
5

Fig.1.

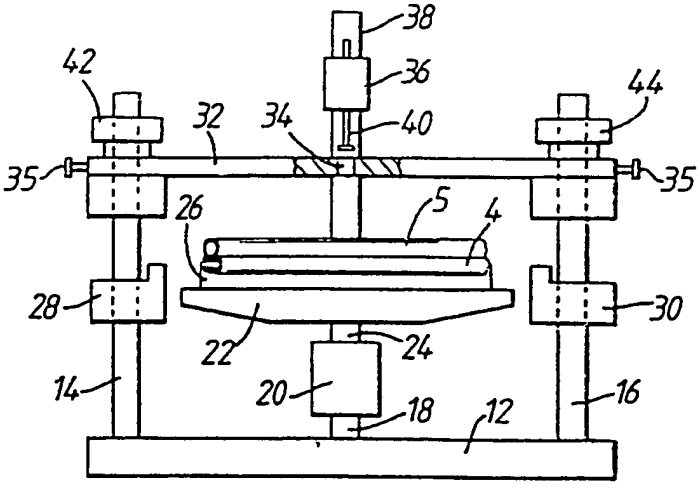
38
42
36
44
32
34
40
35
35
26
5
4
28
30
22
24
14
20
18
12
16

Fig.2.

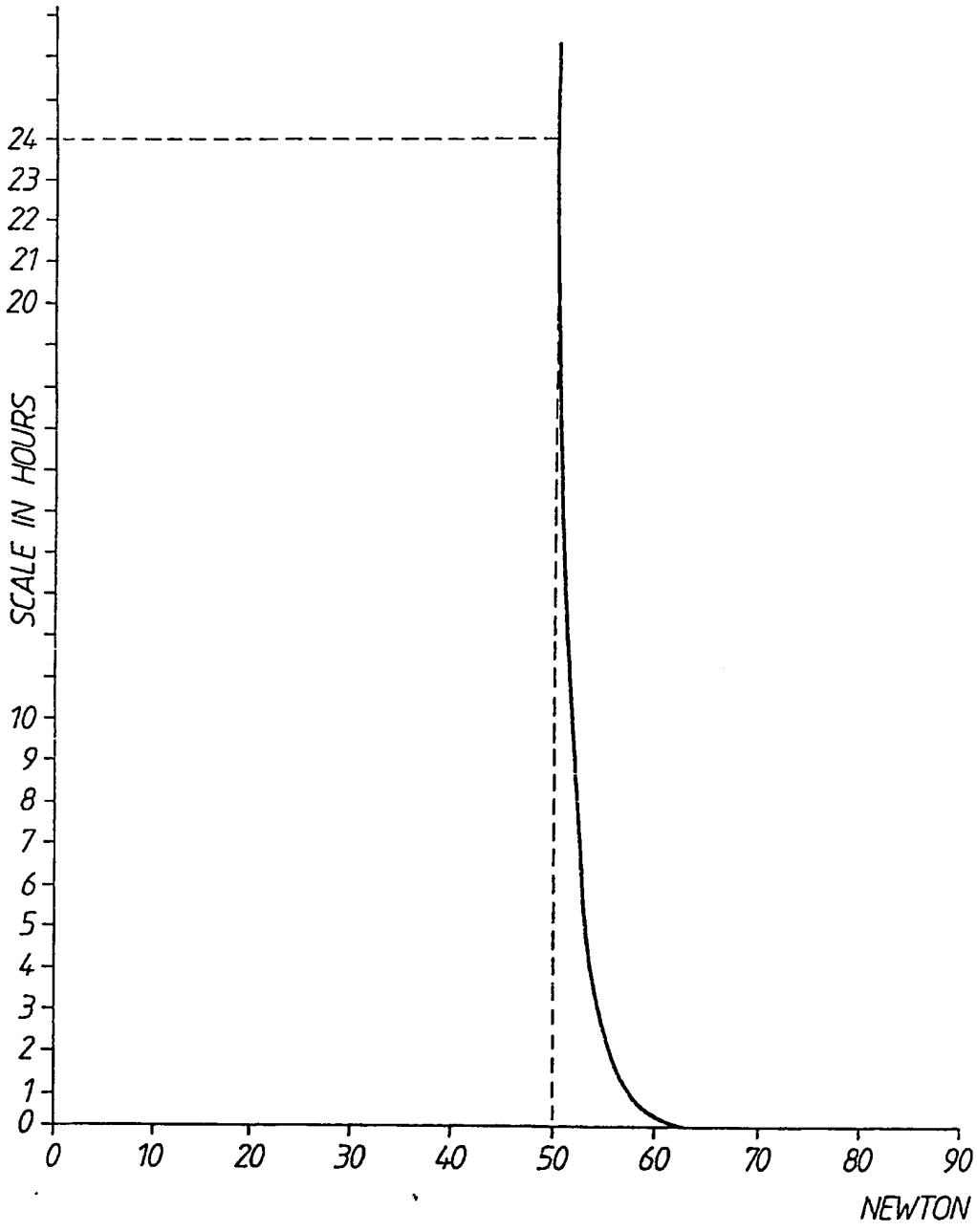
SCALE IN HOURS
24
23
22
21
20
10
9
8
7
6
5
4
3
2
1
0
0
10
20
30
40
50
60
70
80
90
NEWTON

Fig.3.

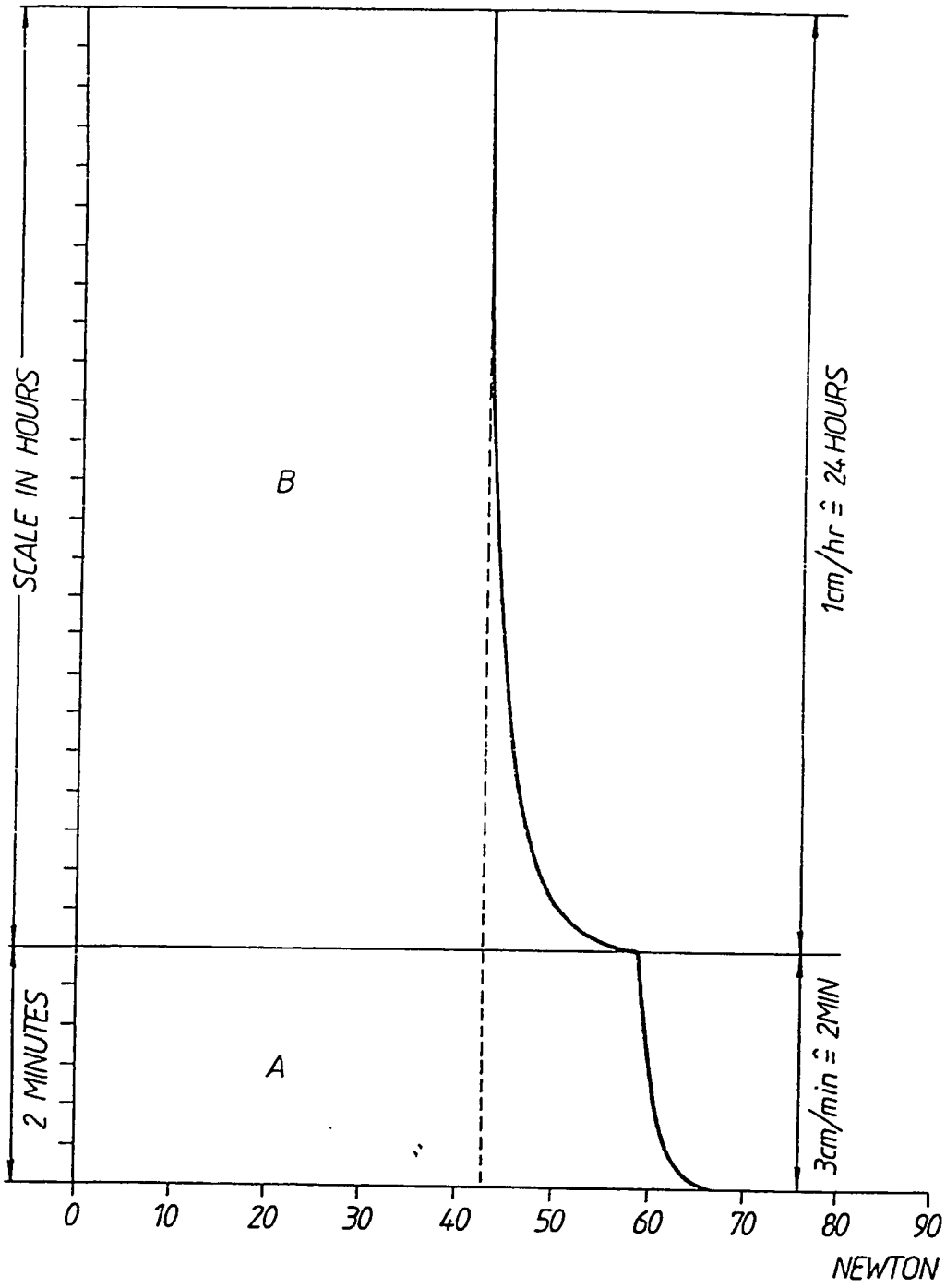
SCALE IN HOURS
B
A
2 MINUTES
1cm/hr ≙ 24 HOURS
3cm/min ≙ 2MIN
0
10
20
30
40
50
60
70
80
90
NEWTON

Fig.4.

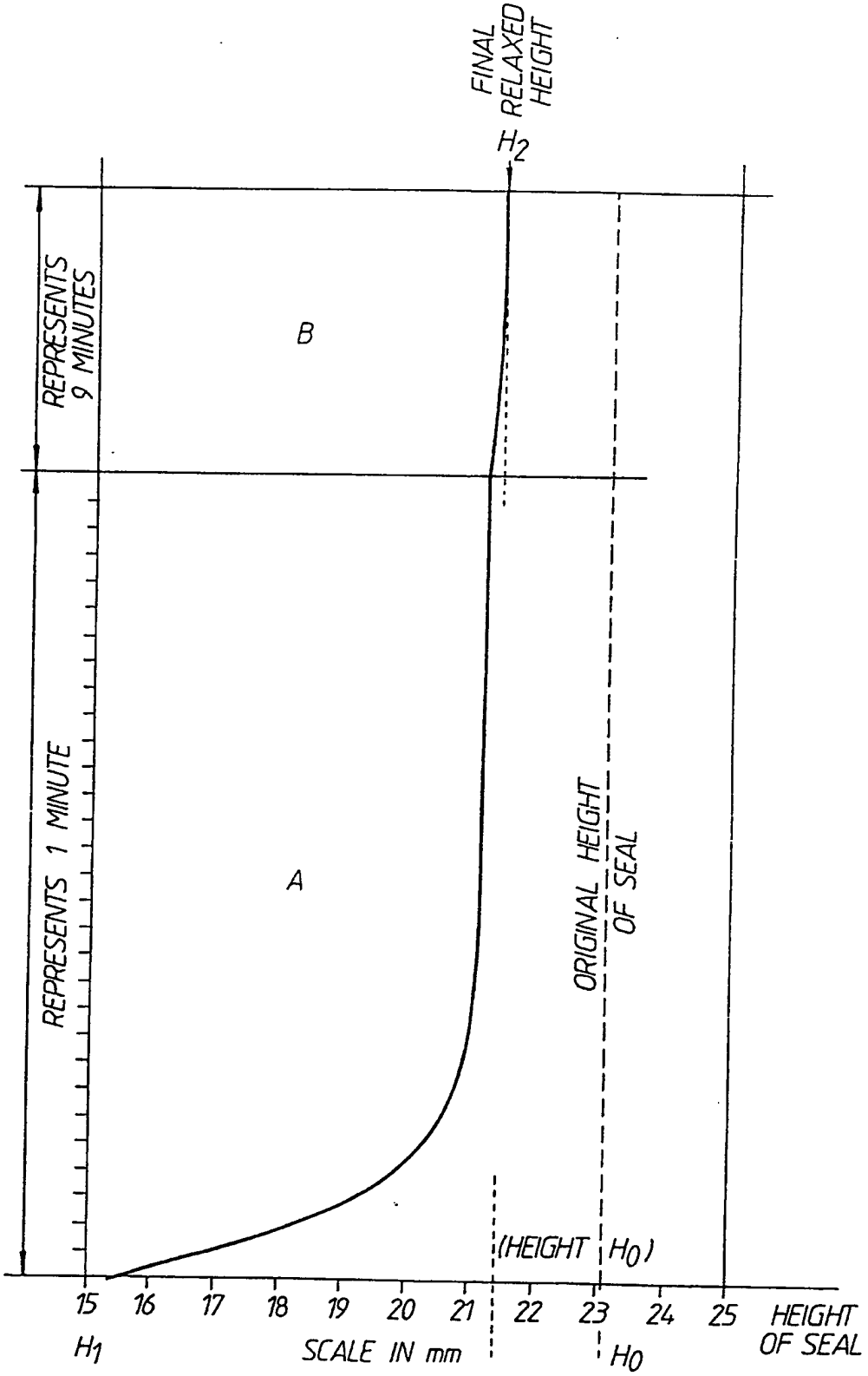
FINAL RELAXED HEIGHT
H_2
REPRESENTS 9 MINUTES
B
A
REPRESENTS 1 MINUTE
ORIGINAL HEIGHT OF SEAL
(HEIGHT H_0)
15 16 17 18 19 20 21 22 23 24 25
HEIGHT OF SEAL
H_1
SCALE IN mm
H_0

Fig.5.

APPARATUS AND METHODS FOR TESTING SEALING STRIPS AND THE LIKE

The invention relates to apparatus and methods for testing sealing strips and the like. Apparatus embodying the invention and methods according to the invention to be more specifically described below are for use in testing sealing strips for sealing between the frame of an opening and the closure member for the opening. For example, such an opening may be an opening, such as a door or other opening in a motor vehicle body. However, other forms of the apparatus and methods can be used in other applications.

According to the invention, there is provided a method of testing a sealing strip, comprising the steps of measuring the value of a predetermined dimension of the sealing strip before any compressive force is applied to it, compressing the sealing strip in the direction of the said dimension to a predetermined extent, maintaining such compression for at least a predetermined period of time, removing the compression of the sealing strip, and monitoring the resiling of the sealing strip.

According to the invention, there is provided apparatus

for testing a sealing strip, comprising support means for supporting the sealing strip, first measuring means for measuring a predetermined dimension of the sealing strip, means for compressing the sealing strip in the direction of the said dimension and such that the dimension has a predetermined value, means for maintaining that dimension substantially constant for at least a predetermined period of time, force measuring means for measuring the initial compressive force on the sealing strip and the compressive force thereon at the end of the predetermined period of time, and dimension measuring means for measuring the change in the said dimension as the sealing strip resiles after removal of the compressive force.

Apparatus embodying the invention for testing sealing strips for motor vehicle bodies, and methods according to the invention for testing such sealing strips, will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a perspective view of a sealing strip which can be tested with the apparatus and by the methods;

Figure 2 is a side elevation of the apparatus; and

Figures 3,4 and 5 are graphs for explaining the operation

of the apparatus.

As shown in Figure 1, the sealing strip comprises a channel-shaped gripping part 4 and a hollow tubular-shaped sealing part 5, the latter being attached to the outside of one of the side walls of the gripping part.

The gripping part 4 comprises extruded plastics or rubber material 6 which is extruded over a channel-shaped metal core or carrier 8. The metal carrier 8 may, for example, be made of U-shaped metal strip elements arranged side-by-side to define a channel and either connected to each other by short flexible connecting links or unconnected with each other. Instead, however, it may be made of wire looped to and fro across the channel. Other forms of carrier can be used instead.

The extruded material 6 is extruded so as to define integral longitudinally-extending gripping lips 10. The gripping lips 10 may be extruded so as to be softer than the channel-shaped material 6. The gripping lips do not have to be arranged as illustrated. There may be greater or lesser numbers of lips on the channel walls.

The sealing part 5 in this example is separately extruded and then adhesively secured to the outside of the gripping

part 4. Instead, however, it could be extruded integrally with the material 6 (but again not necessarily of the same hardness or consistency).

The gripping part 4 may have embedded within it a substantially inextensible ligament which helps to prevent inadvertent stretching of the sealing strip.

In use of the sealing strip, it is mounted to run around the periphery of a door opening on a motor vehicle body. The frame of the door opening is defined by a flanged joint where the inner and outer metal skins of the body are brought together and secured as by spot welding. This flanged joint lies generally in, or at least substantially parallel to, the plane of the door opening (which plane is of course not necessarily flat). The sealing strip is mounted on the vehicle body during assembly of the latter by pressing the gripping part 4 onto the flanged joint so that the latter is embraced by the gripping part and its opposite surfaces are contacted by the lips 10 on opposite sides of the channel. The resilient bias provided by the metal carrier, in conjunction with the gripping lips 10, holds the gripping part 4 securely on the flanged joint. The gripping part 4 is placed on the flange joint so that the sealing part 5 runs around the flanged joint on the outside of the door opening. Therefore, when the door of

the opening closes, it will compress the sealing part 5, partially flattening its tubular shape. The partially compressed sealing part therefore provides a weather-proof seal running around the periphery of the door opening.

Effective sealing depends upon a number of factors. However, it is clearly dependent upon the capability of the material of the sealing part 5 to maintain its resilience over a period of time. Thus, for a major part of its life, it will be compressed by the closed door, and effective sealing requires that such continuous compression does not adversely affect the ability of the sealing strip to maintain sealing efficiency. The apparatus and methods to be described enable this aspect of the sealing strip to be tested.

As shown in Figure 2, the apparatus has a firm base 12 from which extend two uprights 14,16. A central pillar 18, upstanding from the base 12, supports a force measuring unit 20 which is connected to a platten 22 by a probe 24. The platten 22 carries a fixture 26 in the form of a right-angled metal plate extending substantially for the length of the platten 22, this plate providing a flange extending parallel to the surface of the platten and representing the flange of the vehicle door opening. A length of the s aling strip to be tested, approximately

250 millimetres long, is placed on the flange provided by the support 26 so that the gripping part 4 (Fig. 1) grips this flange and supports the sealing part 5 uppermost, as shown in Figure 2.

The uprights 14,16 support vertically adjustable stops 28 and 30 which can be clamped to the uprights at any required vertical position. Also slidably mounted on the uprights 14,16 is a pressure plate 32. The pressure plate 32 has a central hole 34 in alignment with the sealing strip on the platten 26. It is maintained in its vertical position by means of releasable locking screws 35. A height measuring unit 36, slidably mounted on a pillar 38, has a measuring probe 40 which can extend through the hole 34 into contact with the sealing part 5 of the sealing strip.

A pen-recorder (not shown) is provided and can be connected to record, on moving paper, the outputs of the force measuring unit 20 and the height measuring unit 36.

In operation, a sample of the sealing strip to be tested is mounted on the support 26 in the manner described so that the sealing part 5 is supported uppermost. The probe 40 of the height measuring unit 36 is then lowered through the hole 34 into contact with the sealing strip 5 and a

record made of the height of the contacted surface of the sealing part relative to a predetermined datum. This record is thus a record of the relaxed height of the sealing part 5 before the test commences.

The locking screws 35 are then released and the pressure plate 32 is then lowered on the uprights 14,16 until the sealing part 5 has been compressed by a predetermined distance in millimetres, this being measured by the unit 36 whose probe 40 continues to extend through the hole 34 in the pressure plate 32 and into contact with the sealing part 5. The pressure plate is forced downwardly by nuts 42,44 and held in its downwards position by the locking screws 35. The predetermined amount of compression corresponds with the amount of compression which the sealing part would undergo under the action of the closed door on the motor vehicle body.

The pen-recorder is automatically switched on to record the output of the force measuring unit 20 by a micro-switch (not shown) activated when the pressure plate 32 is in its downwards position.

A typical trace produced by the pen-recorder is shown in Figure 3. The horizontal axis plots the force applied to the sealing strip by the pressure plate 32, the force

being in Newtons as measured by the measuring unit 20. The vertical axis plots time in hours. As shown in Figure 3, the force initially measured by the measuring unit 20 is approximately 65 Newtons. In other words, this is the initial compression force acting on the sealing strip and compressing its sealing part 5. However, over a period of time the sealing part 5 gradually "relaxes", producing a reduction of compression force in the sealing part. This is shown in Figure 3 which indicates that the compressive force acting on the sealing strip and compressing the sealing part 5 has fallen to about 50 Newtons after about 20 hours. This relaxation or reduction of contact pressure is explained by a re-arrangement of the molecules of the material of the sealing part 5. Furthermore, it is common for the material of the sealing part to be of cellular or "foamed" configuration, and a further reduction in contact pressure is caused by the air or other gas being forced out of the cells of such material, the extent to which this occurs and its rate being dependent on the extent to which the cells are actually closed and on the density of the outer skin of the material. Such loss of contact pressure over a period of time is of considerable significance to the sealing efficiency of the sealing strip in use. If the contact pressure falls off by too great an amount, then sealing will become ineffective.

Figure 3 also shows that the reduction in contact pressure takes place over a considerable period of time. Therefore, the testing of a sealing part merely by measuring the compressive force required to compress it by a predetermined amount and/or by applying a predetermined amount of compression for a short period of time (e.g. a matter of minutes) and then measuring the degree to which it returns to its original dimension, as has been used in the past, may not give satisfactory results. The graph of Figure 3 shows that it is desirable to delay taking a final reading of the "relaxed" contact pressure until 24 hours has elapsed from initiation of the test. The graph itself also provides important information concerning the suitability of the material of the sealing part 5. For example, it is desirable that the sealing part should reach its "relaxed" state rapidly and thereafter maintain the resultant value of contact pressure.

The graph of Figure 4 corresponds to that of Figure 3 but shows how the use of two different paper speeds in the pen-recorder can assist analysis of the results. Over an initial period of time (marked "A" in Figure 4), the paper has a high transport speed, corresponding, for example, to three centimetres per minute so that region A corresponds to two minutes. This high spe d enables a detailed analysis to be made of the change in contact pressure

which takes place immediately after the initial compressive force has been applied. Over the remainder of the graph (region "B"), the paper has a slower speed (for example, one centimetre per hour) and this enables longer term analysis of the change in contact pressure.

During the test, the probe 40 is maintained in contact with the sealing part 5 through the hole 34. The unit 30 thus measures the compressed height of the sealing part 5. Figure 5 is a graph of the height of the sealing part (plotted on the horizontal axis) against time on the vertical axis. In the example illustrated, it is assumed that the compressed height of the sealing part (the height of the sealing part during the relaxation test mentioned above) is H_1 = 15 millimetres. At the completion of the relaxation test, the locking screws 35 are released as well as the nuts 42,44, and the contact plate 32 is raised to remove the compressive force acting on the sealing part. The sealing part can now resile. As shown in Figure 5, the sealing part initially resiles very rapidly, from a height of 15 millimetres to a height of approximately 21 millimetres. Further resiling then takes place over a period of time and this is measured by the pen-recorder 42 which is now connected to the output of the unit 36. Again, the paper of the pen-recorder is driven at two different speeds during the test.

Initially, the paper is driven relatively rapidly (at 30 centimetres per minute), providing a region "A" lasting one minute. As shown in Figure 5, the sealing part undergoes further relatively slow relaxation during this period and resiles to a height of about 21.3 millimetres. Over region "B" in Figure 5, the paper moves at 1 centimetre per minute and region B therefore represents 9 minutes. During this period, further slow resiling occurs until the sealing part 5 reaches a substantially constant and final relaxed height H_2 = 21.5 millimetres in this example.

The original height of the sealing part (before initial compression by the contact plate 32) is shown at H_o = 23.1 millimetres.

The relative values of H_1, H_2 and H_o, together with the shape of the plot of Figure 5, provide further important information concerning the performance of the sealing part. Clearly, the difference between H_2 and H_o should be as small as possible and the sealing part should resile to H_2 as soon as possible.

The above-mentioned tests can be carried out at ambient temperature or at cold or warm temperatures as required.

Reference is also made to our co-pending United Kingdom patent application No. 9019978.7 (Serial No. 2247956) from which the present application is divided.

CLAIMS

1. A method of testing a sealing strip, comprising the steps of measuring the value of a predetermined dimension of the sealing strip before any compressive force is applied to it, compressing the sealing strip in the direction of the said dimension to a predetermined extent, maintaining such compression for at least a predetermined period of time, removing the compression of the sealing strip, and monitoring the resiling of the sealing strip.

2. A method according to claim 1, in which the monitoring step comprises the step of monitoring the value of the said dimension when it has reached a substantially constant value.

3. A method according to claim 2, in which the length of the said predetermined length of time is many times greater than the time taken for the said dimension to reach the constant value.

4. A method according to any preceding claim, in which the monitoring step includes the step of progressively monitoring changes in value of the said dimension.

5. Apparatus for testing a sealing strip, comprising

support means for supporting the sealing strip, first measuring means for measuring a predetermined dimension of the sealing strip, means for compressing the sealing strip in the direction of the said dimension and such that the dimension has a predetermined value, means for maintaining that dimension substantially constant for at least a predetermined period of time, force measuring means for measuring the initial compressive force on the sealing strip and the compressive force thereon at the end of the predetermined period of time, and dimension measuring means for measuring the change in the said dimension as the sealing strip resiles after removal of the compressive force.

6. Apparatus according to claim 5, including recorder means for recording the change in output of the dimension measuring means as the sealing strip resiles after removable of the compressive force.

7. Apparatus according to claim 6, in which the recorder means comprises means for producing a record of the variation of the said dimension as the sealing strip resiles.

8. Apparatus according to claim 7, in which the recorder means has an adjustably variable time scale.

9. A method according to claim 1 of testing a sealing strip and substantially as described with reference to the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 -16- (The Search report)	Application number GB 9326178.2
Relevant Technical Fields (i) UK Cl (Ed.M) G1S-SAM, SAN, SAP, SAQ, SAR (ii) Int Cl (Ed.5) G01M-13/00 G01N-3/08, 3/10, 3/12, 3/14, 3/16, 3/18	Search Examiner B F BAXTER Date of completion of Search 31 JANUARY 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASE:WPI	Documents considered relevant following a search in respect of Claims :- 1-9

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2156083 A (RUBBER-EN KUNSTSTOFFABRIEK ENB)	1,5

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